Reflection Analysis of Magnetically-Suspended Phase-Borderline Liquid Crystals for Novel Accelerometers

2 April 2024
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Introduction

A sufficiently accurate accelerometer could provide a jamming-proof inertial navigation-based alternative to the Global Positioning System. Such a capability would, if realized, significantly harden existing combat infrastructure, thus increasing the effectiveness of units in of all branches of the military in a potential conflict with a major power.

Abstract

Just as LASERs allow for the precision measurement of temperature in bolometers and are proving to be highly effective in support of an Optical-Atomic Stable Isotope Chronometer (ibid.,) LASERs, specifically as part of systems making use of simple spectroscopy, can form the basis of a revolutionary type of accelerometer based upon the measurement of alterations to the albedo of liquid crystals resulting from changes to G-forces under specific conditions.

Crystalline liquids, including simple frozen water, become more reflective when in the solid phase. Changes in phase from liquid to solid, for example, can be brought about through a decrease in temperature or through an increase in pressure, or by a combination of these two influences.

In the scenario where liquid water, for example, is brought as close as possible to the freezing point without crossing the threshold, the addition of even extremely modest amounts of additional surrounding pressure can bring about a phase change to the solid phase of matter. Nodes of near-frozen liquid crystals kept in thermally-controlled (to high precision) micro-vessels form the basis of a revolutionary type of accelerometer.

Micro-crystals, given their modest weight, can be magnetically suspended and thus held at the center of a chamber in which any addition of pressure to a particular side of a sphere of liquid causes that particular side of the sphere to transition to the solid phase. A previous publication from this author called for a novel accelerometer which functions upon the basis of measurement of the proximity of a magnetized ball bearing to the walls of a housing in which a metamaterial alternatively blocks or allows the innate magnetism of the magnetized ball bearing to pass through the housing and furthermore calls for this proximity to be evaluated through the way in which that magnetism provokes the generation of light in specialized materials just outside of the housing. Although highly effective and accurate, this mechanism, given that it is

highly complex and has a high per-unit cost may be augmented by this newer concept if not supplanted entirely.

In terms of per-unit cost and in terms of accuracy as well as complexity, reflectivity analysis of near-frozen liquid crystals offer a superior accelerometer solution versus any other concept previously promulgated by this or any other author.

If a magnetically-suspended micro-droplet of a magnetically reactive liquid with the property of increased albedo when in the solid phase is exposed to acceleration in any direction under the aforementioned conditions, the amount of light reflected by the droplet could be anticipated to increase to an extent that is proportional to the level of force exerted to compress the droplet. Extreme force might cause the droplet to freeze entirely, whereas more modest amounts of force could be anticipated to cause the droplet to solidify according to a unique pattern. As the shape of the droplet would be stretched as a result of these G-forces, we can predict that, when viewed from the direction of the direction of acceleration or its inverse, a perfectly circular halo absent the increased reflectivity would be measurable around the circumference. Only when viewed from the exact angle of acceleration would this halo form a perfect circle. When viewed from any other angle, this halo would be distorted in ways which would betray the direction of acceleration relative to the angle of observation. Thus, a single nano-/micro-spectrometer could be used to assess direction of acceleration with respect to each droplet with the low-albedo "dark halo" thickness being used to assess magnitude within the regime of the droplet size in question. The dark halo would become progressively thinner until, finally, the entirety of the droplet transitions to the solid phase and reflectivity is maximized for the entire droplet.

Droplets of varying size could be used to enable the measurement of varying degrees of G-force, with the larger droplets being poorly suited for measuring subtle changes to acceleration and the micro-droplets poorly suited to the task of measuring course alterations to G-force. Furthermore, multiple droplets can be used to enable the averaging of a great many nodes in order to improve the accuracy of the system.

Conclusion

The precision thermal control of the chamber housing these droplets would be essential to the proper functionality of the system. As LASER spectroscopy would be capable of registering subtle fluctuations in the reflectivity of such droplets, a hyper-accurate inertial navigation system could be predicated upon such a system of thermal control of a liquid crystal and reflectivity analysis. No longer would accelerometry be a question of measuring the movement of a weight, but rather, would become a question of the evaluation of the tenor and magnitude of alterations to the albedo of magnetically reactive liquid crystal droplets maintained at a near-transition temperature. This takes mechanical limitations upon accelerometry out of the equation and enables the creation of a

purely optical method which is simpler, more compact, requires less power and is cheaper to manufacture.